Energy Management Training for State Agencies and Higher Education

Workshop #2: Optimizing Energy Performance for Fall

A tele-workshop brought to you by:

Colorado Governor's Office of Energy Management and Conservation

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Optimizing Energy for Fall (& Winter)

Tips and strategies for energy conservation without comfort curtailment…

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Agenda

1. **Managing the collar season**
2. **Essentials of an energy management plan**
3. **In the absence of a plan…**
4. **Common energy management and control system optimization strategies**
5. **Open Q&A**

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Educator & Consultant

If You're Not a Part of the Solution,
There's Good Money to be Made in Prolonging the Problem.

Managing the collar season

- **Not uncommon to experience comfort swings in the fall and spring as outside weather changes dictate load changes from heating-to-cooling-to-heating-to-cooling…**
- **In a perfect world (not mine or yours), everything would occur automatically, efficiently and you wouldn't get any hot/cold calls as the weather changes…**
- **How do you manage weather swings without –**
  - **Disrupting comfort**
  - **Stressing HVAC equipment**
  - **Increasing energy consumption**

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Managing the collar season (cont.)

The order of things…

1. **Comfort & safety**
2. **Protect equipment**
3. **Control operating costs (energy, maintenance & repairs, etc.)**

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Managing the collar season (cont.)

Managing comfort as outside weather swings…

- **Have mechanical heating & cooling in "hot standby"**
- **Know the limitations and capabilities of your**
  - **HVAC and controls systems**
  - **Building envelope**
- **Watch the weather forecasts**
- **Adjust start times in response to unoccupied (nighttime) outside temperatures & daytime cloud cover**

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Managing the collar season (cont.)

Managing comfort as outside weather swings (cont.) …

- **Be aware of "mass temperature" phenomena, particularly on morning start-up**
  - **Much easier to manage air temp than mass temp**
  - **Thermal lag, especially on 2-pipe systems**
- **Have contingency plans in the event of unavailability of primary heating/cooling equipment**
  - **Manually adjust outside air quantities**
  - **Adjust primary (VAV) fan volumes**

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Managing the collar season (cont.)

Avoiding HVAC equipment stress as weather swings…

- **Make sure equipment had had proper seasonal start-up and tune-up**
  - **Combustion efficiency**
  - **Heat exchanger cleaning**
  - **Calibration of operating & safety controls**
- **Low load on boilers, chillers and DX cooling can cause undesired short cycling (= excessive wear and tear)**
  - **Match part load to the right equipment**
  - **Modulate supply air and/or water temperatures (manually or automatically) to keep load on primary heating/cooling sources**

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Managing the collar season (cont.)

Optimizing energy as weather swings…

- **Adjust start times in response to unoccupied (nighttime) temperatures**
- **Utilize outside air for free cooling**
- **Adjust temperatures in response to reduced load**
  - **Supply air temperatures**
  - **Heating and cooling supply water temperatures**

  NOTE: **Be cautious that you don't defeat variable air volume and/or variable flow pumping systems**
- **Avoid or minimize simultaneous heating/cooling**

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Managing the collar season (cont.)

Summary…

- **Know your equipment & limitations**
  - **Likelihood of effective automatic operation without human intervention**
  - **Ability to satisfy loads as weather changes**
  - **Part load & efficiency matching**
- **Tune-up, calibrate, etc.**
- **Know your issues and challenges in terms of pre-existing problems**
- **Pay attention to the impact of changing weather**
- **Comfort, process and safety 1st… Then energy efficiency**

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BLAME

THE SECRET TO SUCCESS IS KNOWING WHO TO BLAME FOR YOUR FAILURES.

It must be those darn controls again !!!

Energy Management Plan Basics

1. **Establishing internal alignment around goals, expectations, timing, etc.**
2. **Establishing a baseline of past consumption, demand & cost.**
3. **Benchmarking against a relevant data set**
4. **Doing an "end-use" analysis to establish the biggest pieces of the pie**
5. **Conduct a preliminary assessment**
6. **Document required standards of comfort, process & operations**
7. **Know what you want to do with savings**
8. **Dive into the details to look for savings opportunities**

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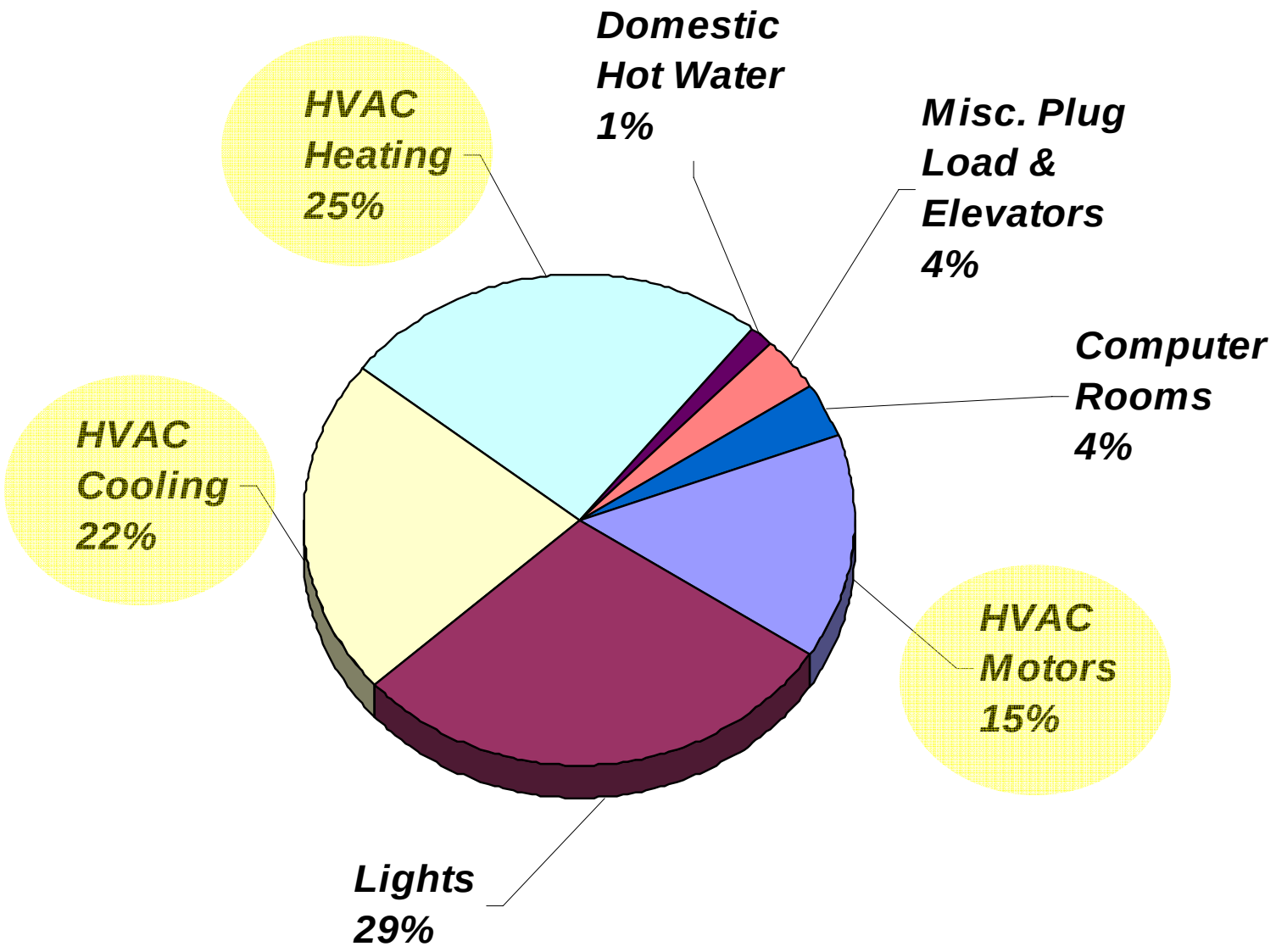
End Use Analysis – Big Hitters



Know what you want to do with the savings…

- **Net reduction in operating costs**
  - **Just looking for low cost ways to reduce energy costs**
  - **Not concerned about asset renewal, fixing problems, etc.**
- **Use savings to pay for needed improvements**
  - **"Performance contracting" model, where you use guaranteed savings to pay for both energy and other needed infrastructure improvements**
- **Once you use them, you lose them (i.e. not available to reallocate to other purposes)**

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In the absence of a plan…

- **Document (for yourself) goals & requirements for –**
  - **Standard building hours, including**
    - Occupancy profile by HVAC area served…
    - Process occupants must follow to get more…
  - **Occupied & unoccupied temperatures**
    - Space temperature
    - Heating system operating parameters
    - Cooling system parameters
    - Process occupants must follow to get more…

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In the absence of a plan… (cont.)

- **Establish & implement a seasonal tune-up plan**
  - **Tasks**
  - **Labor & material resources needed**
- **Calibrate all relevant primary equipment operating and safety controls**
- **Re-commission for functional sequence of operations**
- **Document work performed & problems**
- **Tell your story**

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LIMITATIONS

UNTIL YOU SPREAD YOUR WINGS,
YOU'LL HAVE NO IDEA HOW FAR YOU CAN WALK.

Common energy management & control system optimization strategies

1. **Scheduled on/off operation**
2. **Night setback or setup of space temperature**
3. **Optimal start**
4. **Demand control of ventilation rates**
5. **Supply air temperature reset**
6. **Reset of comfort and/or process heating & cooling supply water**
7. **Steam supply pressure reset**
8. **Condenser water temperature reset for chilled water & refrigeration systems**
9. **Demand limiting (load shed)**

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Common Optimization Strategies (cont.)

Scheduled on/off operation

- **Description –**
  - **Using some form of automatic timer to shut off equipment when it is not needed based on time-of-day and day-of-week**
- **Do's –**
  - **Turn it off when it's not needed**
  - **Turn it back on in time to meet occupied comfort standards**
- **Don'ts –**
  - **Disable automatic operation**
  - **Create comfort or indoor air quality problems**
  - **Create unnecessary or undesired thermal expansion/contraction**

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Common EMS Energy Savings Strategies

Night setback or setup of space temperature

- **Description –**
  - **Using strategically placed space temperature sensors to allow for HVAC to shut down during unoccupied periods without losing ability to warm up or cool down in time for morning occupancy**
- **Do's –**
  - **Setback in the winter; setup in the summer**
  - **The colder it gets… the higher the setback**
  - **Take advantage of outside air temps for warm-up/cool-down, night purge, etc.**
- **Don'ts –**
  - **Lose your load…**

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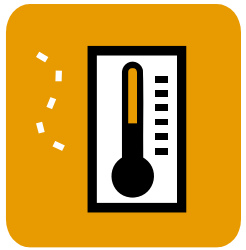
Common Optimization Strategies (cont.)

Optimal start

- **Description –**
  - **Using a smart system to automatically adjust start-up times to the last possible moment and still reach desired occupancy temperature**
- **Do's –**
  - **Let it work**
  - **Fine tune**
- **Don'ts –**
  - **Disable automatic operation**
  - **Create comfort problems by ignoring mass temperature issues**



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Common EMS Energy Savings Strategies

Demand control of ventilation rates

- **Description –**
  - **Minimum outside air quantities are designed for worst case (full) occupancy.**
  - **Can use CO_2 sensors and/or time-of-day and event scheduling to adjust minimums**
- **Do's –**
  - **Reduce minimum outside air settings when reasonable**
  - **Do so in compliance with code**
- **Don'ts –**
  - **Under-ventilate**
  - **Compromise automatic free cooling economizer**

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Common Optimization Strategies (cont.)

Supply air temperature reset

- **Description –**
  - **In many cases, supply air set for constant temp based on worst case (design) heating/cooling load**
    - VAV systems
    - Constant volume reheat
    - Double duct systems
  - **Reasonable to reset (automatically or manually) when load is not at summer/winter design**

Common Optimization Strategies (cont.)

Scheduled on/off operation

- **Description –**
  - **Using some form of automatic timer to shut off equipment when it is not needed based on time-of-day and day-of-week**
- **Do's –**
  - **Turn it off when it's not needed**
- **Don'ts –**
  - **Disable automatic operation**
  - **Create comfort problems**
  - **Create unnecessary or undesired thermal expansion/contraction**

Common Optimization Strategies (cont.)

Supply air temperature reset *(cont.)*

- **Do's –**
  - **Reset when you can…**
  - **Consider impact reset will have on other system dynamics, e.g. reset of supply air temp on VAV system may cause fan to speed up…**
  - **Know where your worst case load is…**
- **Don'ts –**
  - **Kick the energy can around (e.g. VAV example above)**
  - **Make a manual adjustment that defeats the "automatic" operation of your control system**

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Common Optimization Strategies (cont.)

Scheduled on/off operation

- **Description –**
  - **Using some form of automatic timer to shut off equipment when it is not needed based on time-of-day and day-of-week**
- **Do's –**
  - **Turn it off when it's not needed**
- **Don'ts –**
  - **Disable automatic operation**
  - **Create comfort problems**
  - **Create unnecessary or undesired thermal expansion/contraction**

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Common Optimization Strategies (cont.)

Reset of comfort heating & cooling supply water

- **Description –**
  - **Similar to supply air temp control (typically designed for worst case load)**
  - **OK to adjust when at less than full load**
- **Do's –**
  - **Reset when you can…**
  - **Consider impact reset will have on other system dynamics, e.g. reset of supply air temp on VAV system may cause fan to speed up…**
  - **Know where your worst case load is…**
- **Don'ts –**
  - **Kick the energy can around (e.g. VAV example above)**
  - **Make a manual adjustment that defeats the "automatic" operation of your control system**

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Common Optimization Strategies (cont.)

Steam supply pressure reset

- **Description –**
  - **Similar to supply air or water temp control (typically designed for worst case load)**
  - **OK to adjust when at less than full load**
- **Do's**
  - **Reset when you can…**
  - **Consider impact reset will have on other system dynamics, e.g. fixed orifice steam traps…**
  - **Know where your worst case load is…**
- **Don'ts –**
  - **Kick the energy can around**
  - **Make a manual adjustment that defeats the "automatic" operation of your control system**

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Common Optimization Strategies (cont.)

Condenser water temperature reset for chilled water systems

- **Description –**
  - **Condenser water temp typically set for constant value based on worst case cooling load.**
  - **Reducing condenser water temp will lower head pressures and decrease compressor energy use**
- **Do's –**
  - **Know what your chiller system can handle**
  - **Lower is better…**
- **Don'ts –**
  - **Let condenser water temp get too low – could cause oil migration, unstable compressor operation, short cycling, etc.**

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Common Optimization Strategies (cont.)

Demand limiting (load shed)

- **Description –**
  - **Monitoring peak demand and shedding non-essential electrical load to reduce peak demand charges**
- **Do's –**
  - **Use if you're on a demand rate structure**
  - **Identify "sheddable" loads**
- **Don'ts –**
  - **Compromise comfort**
  - **Short-cycle equipment**

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Closing presentation comments…

- **Lots you can do to efficiently maintain comfort**
  - **Automatic & manual…**
- **Weather swings create challenges = opportunities**
- **Work smart, know your limitations**
  - **Resources**
  - **HVAC equipment & building envelope**
- **Have a plan & work it**
- **Ask for help if you need it**

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Closing presentation comments… (cont.)

- **Remember the order of things –**
  1. **Comfort & safety**
  2. **Protect equipment**
  3. **Control operating costs (energy, maintenance & repairs, etc.)**

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AMBITION

THE JOURNEY OF A THOUSAND MILES SOMETIMES ENDS VERY, VERY BADLY.

Open Q & A

WISHES

When You Wish Upon a Falling Star, Your Dreams Can Come True.
Unless it's Really a Meteorite Hurtling to the Earth Which Will Destroy All Life.
Then You're Pretty Much Hosed no Matter What You Wish For. Unless It's Death By Meteor.

Optimizing Energy for Fall & Winter

Thanks for your participation, good luck this fall/winter and please feel free to call if we can be of any assistance !!!

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